

# PROJECT facts

## Sequestration

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U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY



## ASSESSING FOSSIL AND RECENT CARBON POOLS IN RECLAIMED MINED SOILS

### Background

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There is ample indication that reclaimed mine lands have great capacity to sequester carbon. This carbon could offset CO<sub>2</sub> emissions associated with extraction and burning of coal and provide public utilities and other industries with carbon credits. However, at the present time, estimates of carbon pools in reclaimed mined lands are uncertain. This uncertainty is primarily linked to failure to account for carbon associated with coal particles and, given the variability of soil properties at reclaimed land sites, lack of standardized sampling protocols in assessing carbon pools.

Organic carbon present in mined lands is a mixture of carbon from coal particles (old carbon) and carbon resulting from decomposition of plant residues (recent carbon). In these soils, carbon sequestration essentially refers to the increase in the new carbon pool. However, because of their high carbon content, coal particles represent a large carbon background against which detection of small increases in recent C are difficult to determine. This is an analytical challenge that needs to be resolved in order to generate credible information on carbon sequestration rates in reclaimed mined lands.

In nature, carbon occurs as stable isotopes <sup>12</sup>C and <sup>13</sup>C (1.12% of atmospheric CO<sub>2</sub>) and as the radioisotope <sup>14</sup>C (half-life of 5,730 years). Given that coal was deposited several hundred million years ago, coal shows no radiocarbon activity. Thus, <sup>14</sup>C activity recorded in soil samples from reclaimed mined lands can be attributed to new carbon. Although this approach has been successfully used in assessing the contribution of lignite to carbon pools in reclaimed lands, high cost precludes widespread adoption of this technique. In this study, radiocarbon activity will only be used to validate the proposed chemo-thermal and <sup>13</sup>C-based procedures. The <sup>13</sup>C approach exploits differences in <sup>13</sup>C composition between coal and new carbon that is the result of the decomposition of plant residues (e.g., corn), making it possible to partition the total carbon pool in reclaimed soils into coal carbon and recent carbon. The chemo-thermal procedure assumes that coal carbon is less reactive than recent carbon. Therefore, a series of chemical and thermal treatments will be applied to selectively remove the new carbon from the sample so that the refractory coal carbon left behind can be quantified.

This project will include mining sites, reclaimed cropland with a recent corn crop, and reclaimed grassland at various locations across a 300-400 km transect spanning the Northern Appalachian coal basin in Ohio, West Virginia, and Pennsylvania. Topography- and grid-based soil sampling will be conducted at selected reclaimed grassland sites, and through assessment of the spatial patterns of carbon distribution, a sampling design will be proposed to better estimate carbon in reclaimed mined lands.



## CUSTOMER SERVICE

1-800-553-7681

## WEBSITE

[www.netl.doe.gov](http://www.netl.doe.gov)

## PARTNER

The Ohio State University  
Research Foundation

## COST

Total Project Value  
\$551,719

DOE/Non-DOE Share  
\$425,532/\$126,187

## Primary Project Goal

The primary goal of this project is to develop and test several analytical procedures that can determine the amount of coal-derived C in reclaimed mined lands.

## Objectives

The objectives of this project are:

- To develop and test a  $^{13}\text{C}$ -based procedure to determine the fraction of coal carbon present in reclaimed soils.
- To evaluate a chemo-thermal procedure, based on the lower reactivity of coal carbon compared to recent carbon, to partition organic carbon in reclaimed soils into coal-derived and newly-deposited carbon fractions.
- To establish an optimum sampling protocol (intervals and number of sampling points) to produce an accurate assessment of carbon sequestration in reclaimed mined lands.



Coal mined lands in southeastern Ohio

## Accomplishments

- Two chemical methods were modified and tested for selective removal of recent Carbon in minesoils:
  - NaOH extraction
  - Acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  oxidation
- Soil coal mixture analysis indicated that both methods were effective in removing recent C with little effect on coal C.
- Dichromate oxidation removed greater percentage of organic matter from coal-soil mixture than NaOH-extraction-combustion method.
- Estimated coal C in minesoils ranged from 4 to 67% of soil organic carbon (SOC), showing the necessity of having methods to differentiate old and new carbon pools.

## Benefits

One option for sequestering  $\text{CO}_2$  is by increasing the amount of carbon stored in reclaimed mined lands. However, to allow credit for such sequestration there must be methods to verify the increased carbon content of the soil. That is, there must be analytical techniques which can accurately determine recent carbon. A major problem, however, is the presence of coal carbon, which greatly increases the difficulty of accurately determining recent carbon. By addressing this problem, this project will make a significant contribution to determining the viability and the potential of carbon sequestration in reclaimed mined land to reducing greenhouse gas emissions in the United States.